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Learning, friendship and social contexts




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# Learning, Friendship, and Social Contexts: Introducing a social network analysis toolkit for socially responsive classrooms


## Abstract

Socially responsive classrooms can be pivotal for learning. Educators are being asked to create more inclusive, culturally and socially responsive learning environments and be leaders for learning, but without being given appropriate or sufficient tools, resources, and training to do so. This paper aims to introduce a social network analysis (SNA) toolkit aiming to enable educators and researchers work together to deepen their understanding of classroom social network dynamics. In doing so, we provide both theoretical and practical steps in building a bridge between theory and practice and a step-by-step introduction to designing and implementing SNA to understand socially responsive classrooms. To make our case, we present data that were collected through a SNA survey completed by eighth graders in two highly-diverse classrooms in Southern California. Our objective was not to compare the classrooms but rather to exemplify the potential use of the toolkit in beginning to understand the social responsiveness and inclusivity of those classrooms. Driven by a social network analysis perspective, we highlight the potential value of examining social interdependencies and interconnectedness among students in a classroom network. The SNA toolkit was employed to calculate social network measures and develop network maps for each classroom. The toolkit has shown to provide a comprehensive platform in gaining important insights into students' social relationships, particularly those who are underserved and at higher risk of exclusion. The toolkit in the hands of educators may provide a powerful tool for personalized professional development and act as a catalyst in bridging the gap between research and practice.

## Purpose

The main purpose of this paper is to introduce a Social Network Analysis (SNA) toolkit to enable educators and researchers work together to deepen their understanding of classroom social dynamics. In doing so, we provide both theoretical and practical steps in building a bridge between theory and practice and a step-by-step introduction to designing and implementing SNA research to understand socially responsive classrooms. To address this purpose, we draw on relational data collected from two cognitively, linguistically and racially diverse Grade 8 classrooms who completed a social network survey. These two classrooms have been selected to demonstrate how the SNA toolkit can be used to explore the social responsiveness of classrooms in public schools. A specific advantage of the toolkit is that it can easily provide a snapshot of social relationships within a classroom and help educators identify students who may be at higher risk of exclusion, such as students with disabilities, racially and cognitively diverse students, English language learners and other.

## Theoretical framework

### *Social Capital Theory*

One of the conceptual foundations in understanding social networks is social capital theory (Daly, 2010). A key notion of social capital is that social relationships provide access to resources that can be exchanged, borrowed and leveraged to facilitate achieving goals (Moolenaar et al., 2012). According to Bourdieu (1986) social capital is the aggregate of the actual potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition. Therefore, social networks have value (Putnam, 2000), as they are a kind of social capital and social capital can be a fitting topic for summarizing the field of social networks (Kadushin, 2012).

As resources can "flow" through social relationships and have value, they can be shared, mobilized or even hoarded. In this regard, social capital can be thought of as the 'resources and information' (Baker-Doyle & Yoon, 2010), which can be mobilized when an individual seeks to increase the likelihood of success in purposive action (Finnigan & Daly, 2010). The attainment of social capital is reflected in the ability of individuals to leverage relational ties to successfully engage with or share (or transmit) with others (Borgatti et al., 2013). This idea implies that there is a network of relationships between and among individuals that can be examined. This pattern of social ties creates ecosystems of relationships in which individuals can be located based on their "structural position" in a network. One's position is related to the pattern of social ties that surround an actor and others that are in the network. A student may be central in a network (meaning a lot of incoming and outgoing ties) or even peripheral, as is the case with individuals with fewer ties.

While several scholars have recently started to embrace social capital theory as a valuable lens to examine social interactions (see e.g., Moolenaar, 2010; Daly & Finnigan, 2010), the idea of 'social embeddedness' of students in social networks and how the ecosystem of relationships may support or constrain learning and development is ripe for study. However, an important prerequisite for gaining insight in the potential of social interactions for students is a deepened understanding of the structure and content of peer relationships. Therefore, this study highlights the importance of social network analysis as an interdisciplinary set of methods for more carefully examining dynamic peer relationships (see e.g., Borgatti et al., 2013; Kadushin, 2012; Scott, 2013; Scott & Carrington, 2012). This study introduces a social network analysis toolkit for practitioners, researchers and other professionals to study, understand, and support the development of socially responsive classrooms.

*Socially Responsive Classrooms*

Within the context of this study, socially responsive classrooms are being broadly defined as classrooms that, in addition to students' academic outcomes, pay equal attention to social and emotional aspects of learning, including students' social interactions, wellbeing, friendships and overall peer relationships. In such classrooms, educators strive to create the conditions for enhancing positive social interactions and are systematic about understanding and constantly improving the inclusion and active participation of all students in teaching and learning. We argue that socially responsive classrooms may be conducive to improving students' learning, socioemotional wellbeing, sense of belonging, and act as a buffer to students' stress inside and outside of school. However, despite the known and widely accepted importance of socially responsive classrooms, researchers and particularly educators struggled to come up with ways of understanding students' social interactions and peer relationships (Saldarriaga, et al., 2015).

To address this gap, we offer in this work a perspective and a set of tools to enable both educators and researchers for more deeply understanding the social aspects of learning. In addition, the introduction of a SNA toolkit seeks to provide a bridge between research and practice. The toolkit, as we envision, will also create new opportunities for educational researchers and practitioners to partner on important issues of practice. In this study, we present and elaborate on data collected from two Grade 8 classrooms in Southern California to highlight the feasibility and simplicity of the toolkit, as an innovative approach in collecting and analyzing relational data.

*Social Network Analysis Toolkit*

The SNA toolkit is grounded in social network analysis principles. A social network can be described as 'a way of thinking about social systems that focus on the relationships among the entities (actors or nodes) that make up the system' (Borgatti et al., 2013, p.1). It consists of actors or nodes (e.g., students) and ties or links that connect the actors/nodes (e.g., being friends, working

together, asking for help). Social network analysis is primarily concerned with network structure and position of an actor within a network (Borgatti et al., 2013). For example, the structure of a classroom network may be important in understanding and improving the pedagogical eco system of that classroom whereas the individual position of students may be revealing of students who are at risk of social isolation and exclusion. What is may even more important is that network structure and position drive the flow of resources or learning opportunities in a classroom through the channel of interpersonal relationships. Perhaps not surprisingly, social network analysis has gained popularity in the last couple of decades due to its theoretical and methodological novelty as well as advances in computational sciences that allow for complex social network concepts to be computed quickly and presented visually. The field of education has only recently begun using network analysis to explore youth networks, but there is still scope for further study. Therefore, the proposed SNA toolkit is expected to accelerate this process by providing a platform to educators and researchers for undertaking social network research.

**Design/methodology/approach**

Classroom social network research requires rigorous and careful designs. In collecting the data from the two classrooms, we implemented a quantitative social network survey that asked students four questions; 1. Who are your friends in this classroom? 2. Who do you hang out with outside of class? 3. If your teacher is not around, who do you turn to for help on school work? 4. If you are having a bad day, who do you talk to? In each question, students were provided with a classroom roster and were asked to check as many names as they wanted in each question. The roster is more advantageous as it reduces the recall error and students get the chance to respond for each of their classmates (Scott, 2013). The advantage of such a quantitative design is that it is efficient, low cost and quick in collecting data and can yield valuable information about the classroom network. This type of design is particularly useful for generating a 'snapshot' of the social dynamics within a

classroom. However, despite these advantages, this design can barely explain the process of the development of this structure (Crossley & Edwards, 2016). Therefore, it would be useful to collect data in different points in time from the same students so the evolution of relationships may be better captured.

We administered the survey to all students in both classrooms. The informed consent from parents was sought in advance as well as the students' assent. In Classroom 1 (C1), 31 out of 34 students completed the survey, resulting in a 91.2% response rate. In classroom 2 (C2), the response rate was 87.5% meaning that 28 out of 32 students completed the survey. It should be noted that for efficient whole network analysis, at least 80% of students in a classroom should respond to the data collection instrument (Neal, 2008). Missing data can be an issue in this type of network analysis (Borgatti & Ofem, 2010).

In terms of students' demographics, we selected these two classrooms as they are highly diverse and relatively typical of the wider school district. About 60% of the district's student population consists of students with a Hispanic ethnic background (Race and Ethnicity: RE) and about 30% are students who are learning English as a second language (English Language Fluency: ELF). Additionally, three in five students are eligible for Free or Reduced Lunch (FRL) and about 15% are students identified as having Special Educational Needs and Disabilities (SEND). Table 1 provides more details as to the actual demographic composition of the participants in our study.

Table 1. *Participants' demographics*

| | **Gender** | **RE**[1] | **ELF**[2] | **FRL** | **SEND** | **GPA (0-4)** |
|---|---|---|---|---|---|---|
| **C1** | Girls: 17<br>Boys: 17 | HLO: 22<br>BAA: 1<br>WA/W: 9<br>NA/AN: 1 | EO: 18<br>EL: 5<br>FUE: 0<br>R: 11 | F: 17<br>R: 2<br>N/A: 15 | Yes: 7<br>No: 24 | ≥3: 14<br><3: 20 |

[1] Hispanic or Latino Origin (HLO), Black and African American (BAA), White American/White (WA/W), Native Americans and Alaska Native (NA/AN), Native Hawaiians and other Pacific Islanders (NH/OPI), Asian American (AA), Not Disclosed (ND).
[2] English Only (EO), English Learner (EL), Fluent Upon Entry (FUE), Redesignated (R).

| | | | | | | |
|---|---|---|---|---|---|---|
| | | ND: 1 | | | | |
| **C2** | Girls: 18<br>Boys: 14 | HLO: 17<br>BAA: 5<br>WA/W: 7<br>NA/OPI: 1<br>AA: 1<br>ND: 1 | EO: 18<br>EL: 3<br>FUE: 0<br>R: 11 | F: 16<br>R: 3<br>N/A: 13 | Yes: 8<br>No: 24 | ≥3: 17<br><3: 15 |

## Results and Substantiated Conclusions

*Data visualization and network maps*

Network data visualization is the first function of the toolkit in terms of analyzing relational data. The toolkit was used to produce four network maps for each classroom, one for each survey question/network; 1. Who are your friends in this classroom? (Friendship network) 2. Who do you hang out with outside of class? (Hang out network) 3. If your teacher is not around, who do you turn to for help on school work? (Help network) 4. If you are having a bad day, who do you talk to? (Talk network). A network map includes all nodes/actors in the classroom network, lines that connect actors with each other, and arrows that show the direction of ties. The lines connecting the nodes show whether a relational tie exists between two students. Network maps can be valuable visual tools as they provide a snapshot of the social dynamics within a classroom. Working with network maps enables educators and researchers to draw conclusions that would otherwise not be possible. The following figures provide all network maps developed across the two classrooms (C1 and C2).

Figures 1 and 2 show the friendship networks across the two classrooms. Students were asked to select as many classmates from their classroom roster that considered them to be their friends. Orange nodes represent students with SEND. Circles show girls and squares represent boys. The node size is set based on in-degree; number of friendship nominations received by each student.

More friendship nominations equal to higher in-degree, hence larger node size. For example, students 9 and 22 seem to have the highest in-degree in C1 and C2 respectively.

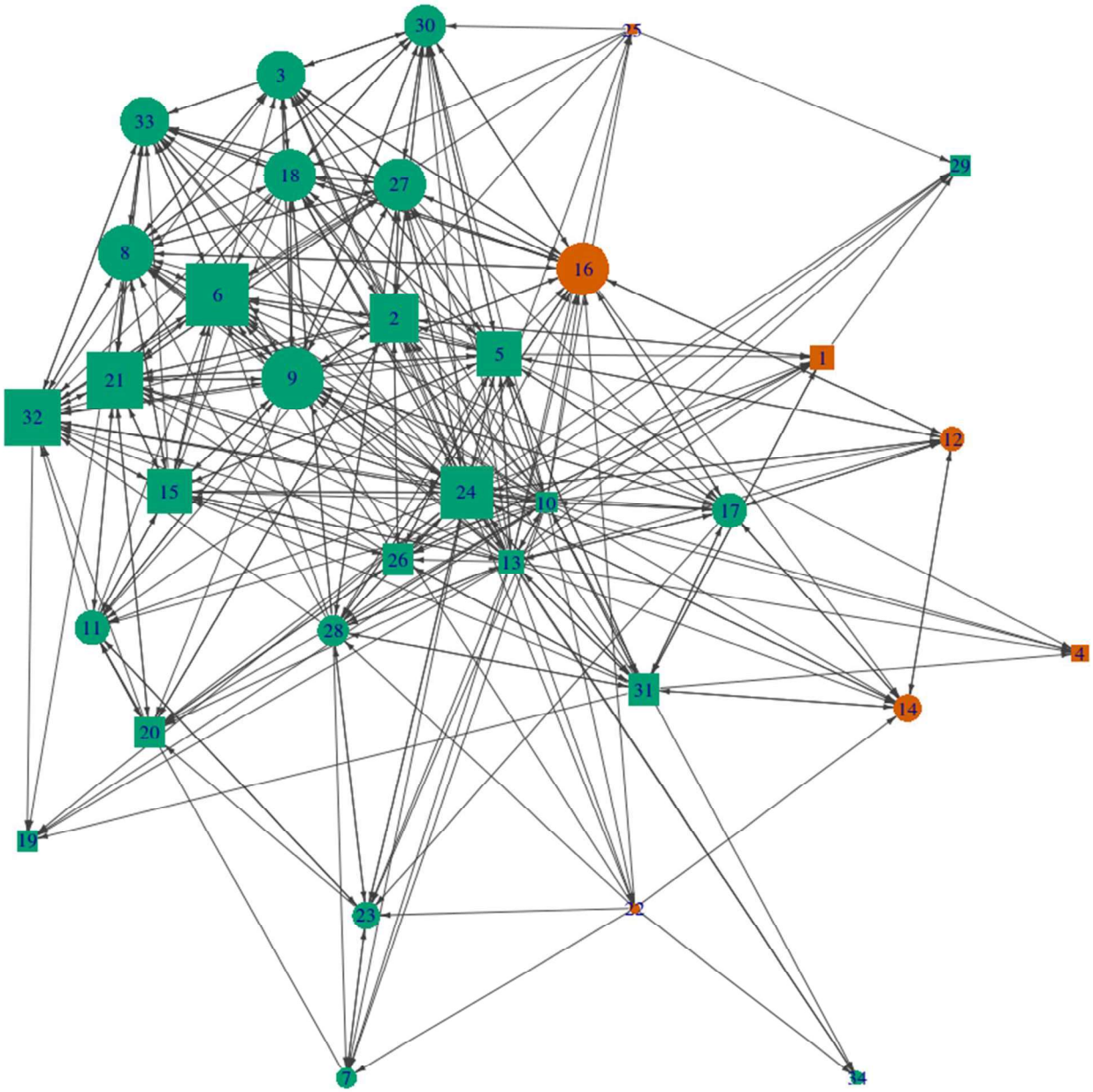


***Figure 1.*** **C1 friendship network by gender and SEND**

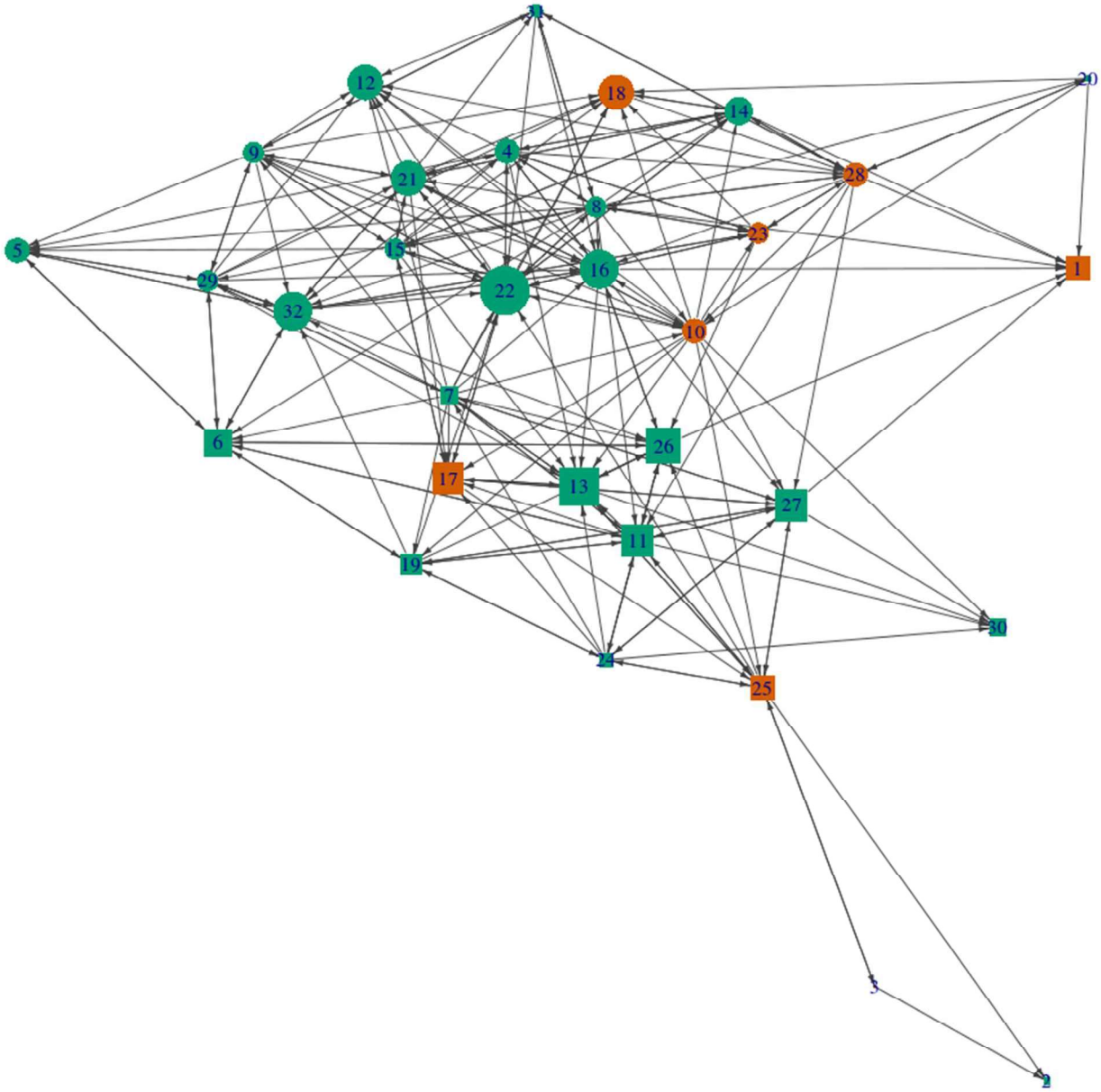


***Figure 2.*** **C2 friendship network by gender and SEND**

A closer look at both network maps shows a relative gender division, as girls and boys occupy particular clusters in the network. Overall, students with SEND in C1 (1, 14, 4, 16, 22, 25, 12) seem

to have less friendship nominations (smaller node size) than their peers without SEND and primarily lie on the periphery of the network. Girl 16 appears to be an exception as her node size is considerably bigger than the rest of SEND students. In C2, students with SEND seem to be more embedded in the friendship network, but still seem to have a relatively smaller node size compared to most peers without SEND. Table 2 shows the identified SEND for each student.

Table 2. *Students with SEND*

| **C1** | **C2** |
|---|---|
| 1. Specific Learning Disability | 1. Autism |
| 4. Autism | 3. Speech or Language Impairment |
| 12. Specific Learning Disability | 10. Specific Learning Disability |
| 14. Specific Learning Disability | 17. Intellectual Disability |
| 16. Specific Learning Disability | 18. Specific Learning Disability |
| 22. Specific Learning Disability | 23. Specific Learning Disability |
| 25. Other Health Impairment | 25. Specific Learning Disability |
| | 28. Specific Learning Disability |

Based on the district's special education assessment, most of the students in both classrooms have been identified as having a specific learning disability. One student in each classroom has been identified as having autism whereas the rest have been identified as having a speech or language impairment, other health impairment and intellectual disability. Within a special education context, the above visual maps may help us identify the position of students with SEND in their social networks. Primarily, in both classrooms these students seem to have less friendship nominations received (smaller node size) and are mostly on the periphery of the friendship networks, especially in C1. This knowledge is very important at the hands of educators, in their quest of creating and managing more socially responsive and inclusive classrooms. Network visual maps seem to be revealing of students who may have less friendships and are potentially at risk of social exclusion. Additionally, social network measures, as shown in the section below, provide another layer of evidence which may be helpful in interpreting what we see on a social network map. For example, the in-degree scores of students with SEND may be compared to their peers without SEND and establish whether indeed the former have less friendship nominations received than the latter.

Figures 3 and 4 show the networks of interactions outside of the classroom by race and ethnicity of students. Circles show boys and squares represent the girls. The different colors show race/ethnicity of students: Hispanic and Latino Origin (orange), Black and African American (light blue), White American/White (Green), Native Americans and Alaska Native (yellow), Native Hawaiians and other Pacific Islanders (blue), Asian American (red), Two or More Races (purple), Not Disclosed (no color). A look at these two figures may reveal some relative racial segregation, especially in C1. On the one hand, White American/White students seem to be concentrated close to each other on the right-hand side of the network in C1 (15, 20, 6, 21, 32, 33, 27), which suggests that they mostly hang out together outside the classroom. A similar but weaker pattern may be seen in C2, on upper right-hand side of the network (5, 6, 29, 32, 31, 16, 26). On the other, Hispanic and Latino students, who are the majority in both classrooms, seem to hang out mostly with each other. A useful network measure to show whether this is the case is homophily (see table 5) which is explained and calculated in the following section. In terms of gender, it also seems that there is some fragmentation between boys and girls, especially in C2 (see table 5).

Educators using the toolkit may get an instant snapshot of the social relationships outside of the classroom and identify students that may be isolated. In such cases, educators may design social inclusion interventions to cultivate a more welcoming and caring environment so students can more easily connect to each other. There can also be interventions to promote more inter-group interaction among racially diverse students or boys and girls.

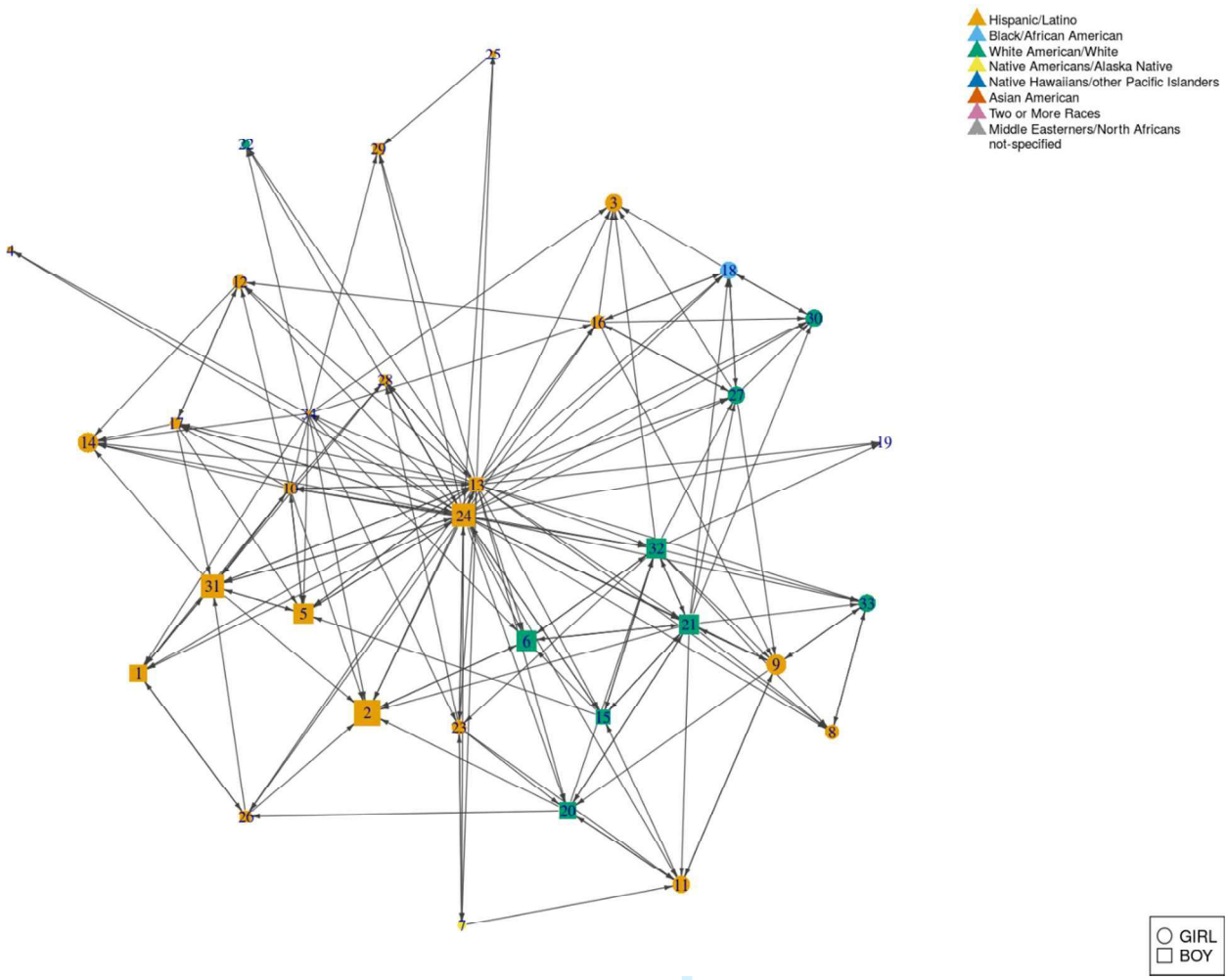


***Figure 3.*** **C1 hang out network by gender and race/ethnicity**

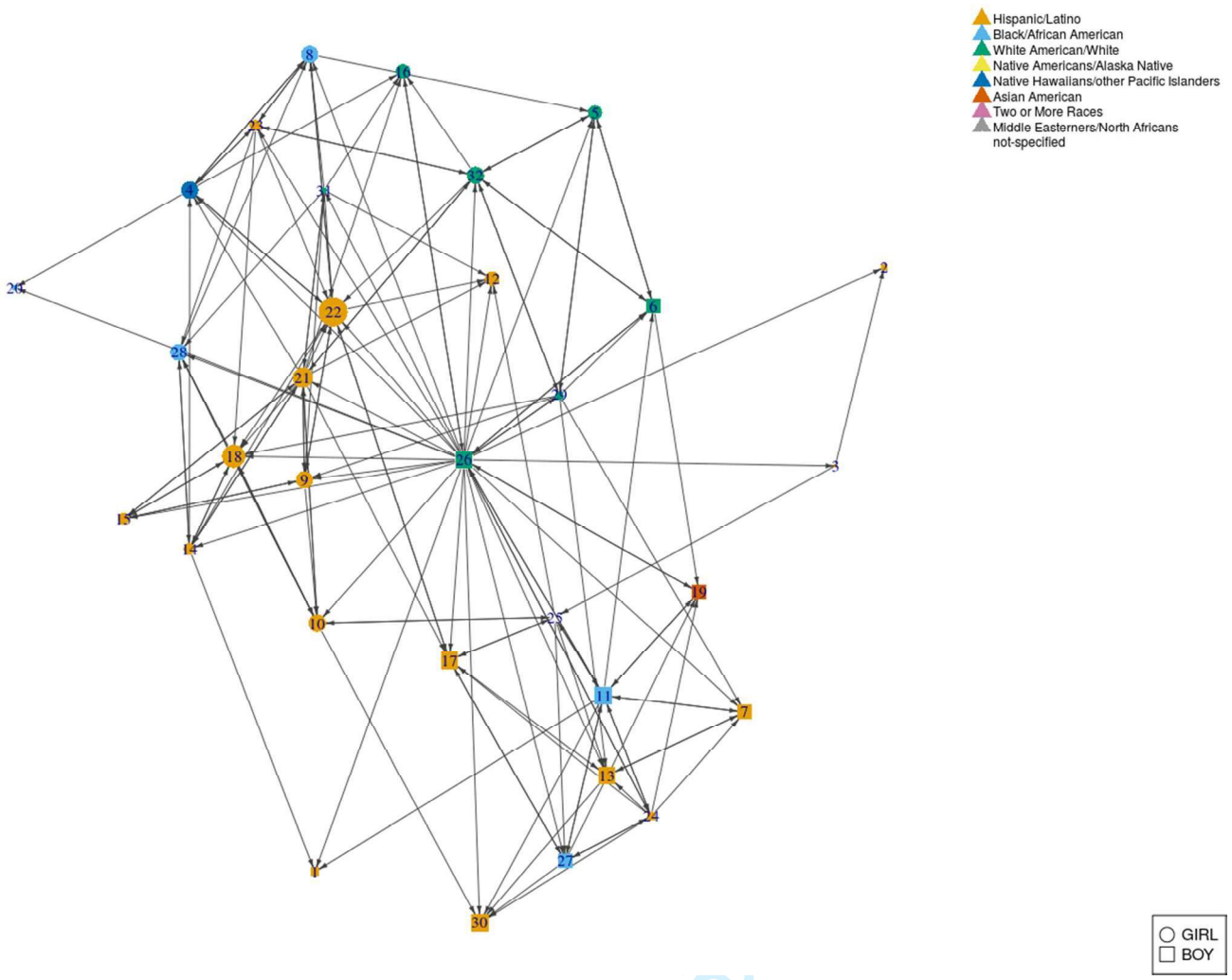


***Figure 4.*** **C2 hang out network by gender and race/ethnicity**

Another important dimension of peer social capital is the support (help network) that students provide and receive from each other. Figures 5 and 6 present the help networks across the two classrooms.

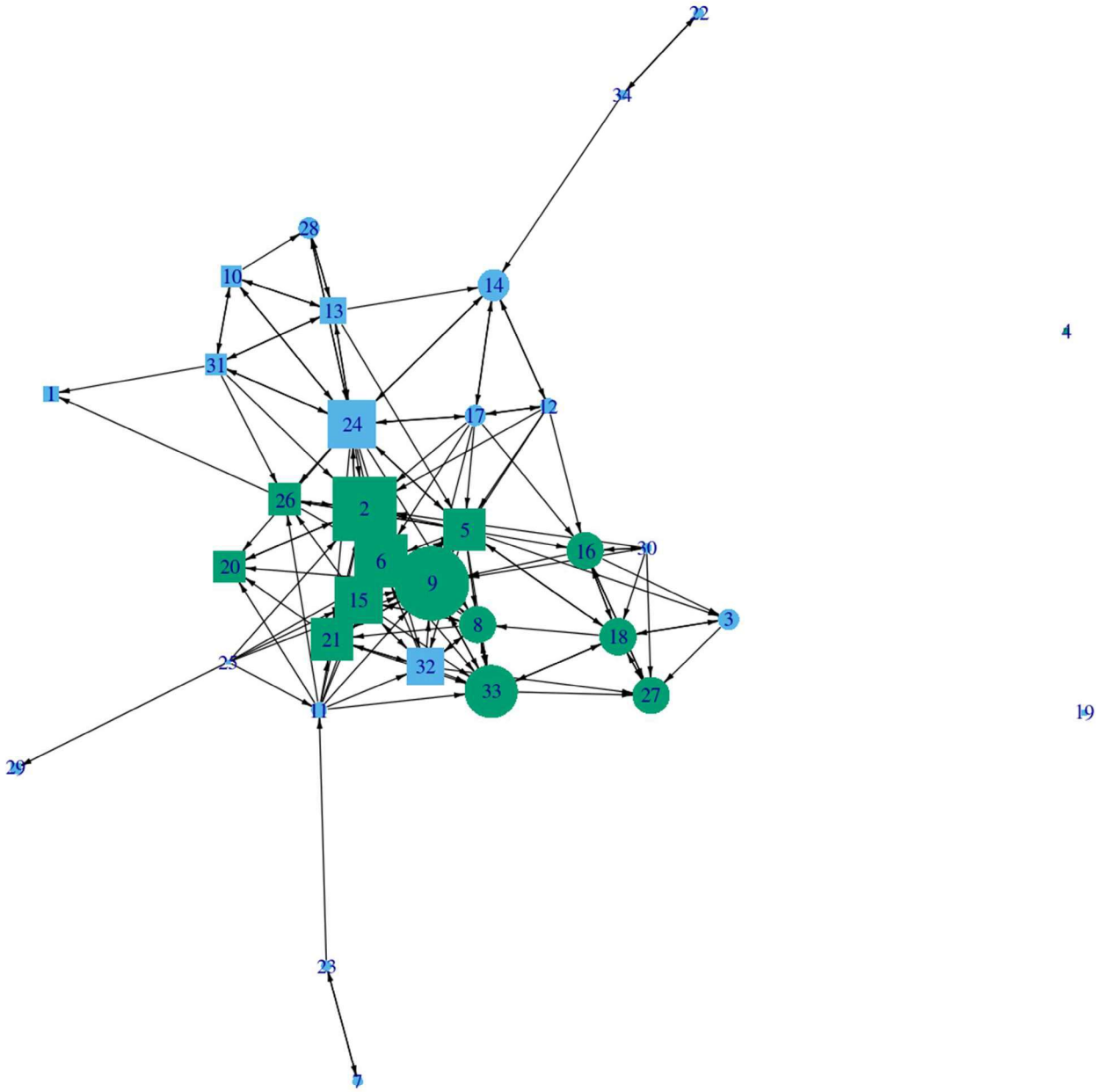


***Figure 5.*** **C1 help network by gender and GPA**

Square nodes show boys and circles show girls. Green shapes show students with GPA higher or equal to 3, whereas blue show students with GPA lower than 3. Particularly in C1, as shown on the network map, students with higher GPA (green) seem to be the primary sources of help/learning support as their node size is considerably bigger than students with lower GPA (blue). However,

there are some students with lower GPA that still many other students go to them for help on school work, such as students 24 and 32 in C1 and students 8, 18, 21 in C2. Through the visual maps alone, we cannot interpret these results fully but classroom educators who know their students best may be have more insights as to the underlying reasons for the structure of these networks. For this reason, we believe the toolkit may provide a useful set of tools for educators to get a 'bird's eye view' of their classroom. From a research standpoint, a researcher may follow up with student and teacher interviews so to get insights into the network structure. As in previous networks, gender segregation of students seems to be prominent in these networks, particularly in C2.

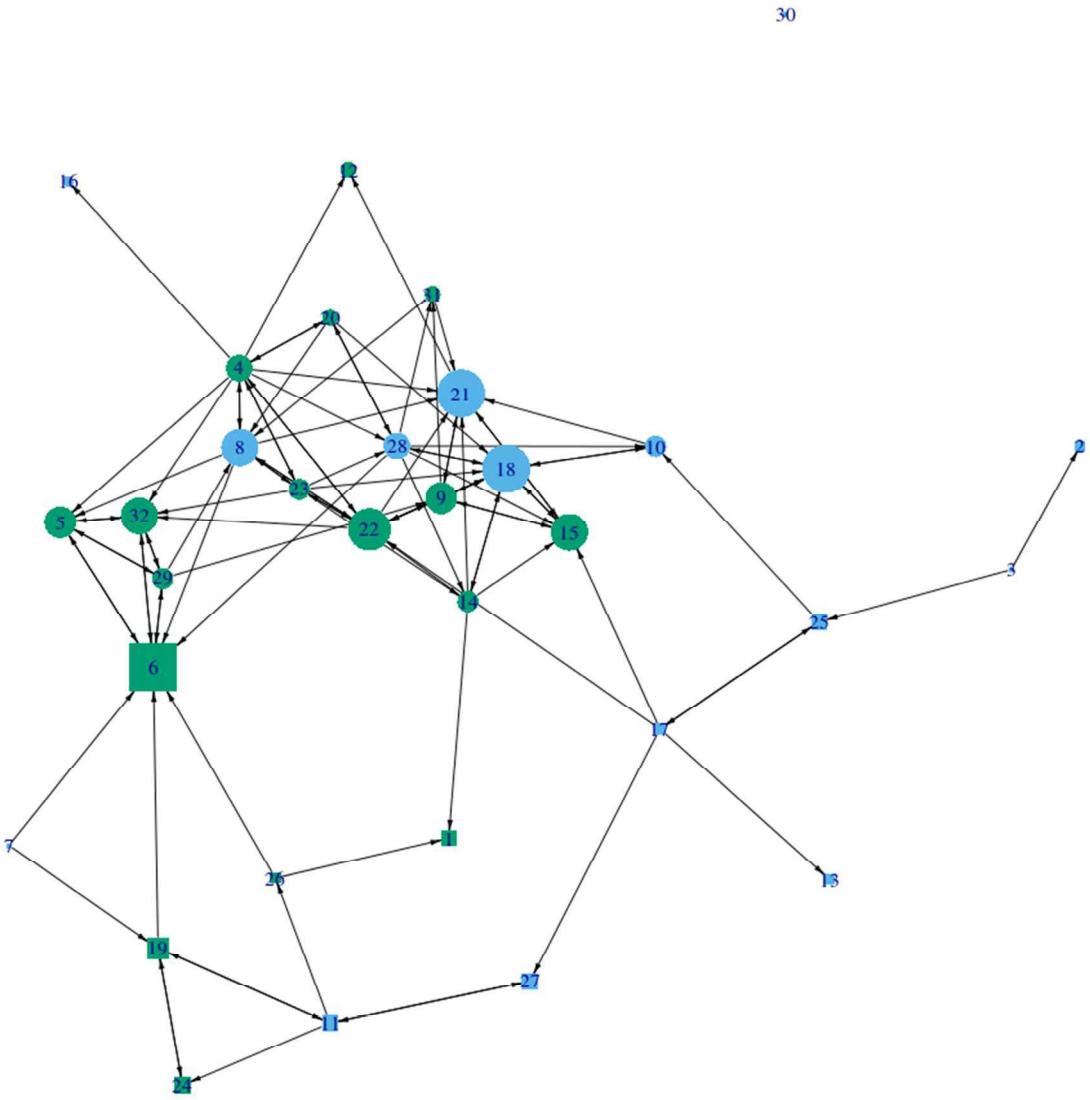

***Figure 6.*** **C2 help network by gender and GPA**

Last but not least, figures 7 and 8 show the talk networks in the two classrooms, based on gender and English language fluency. Students were asked to check the names of as many classmates in their classroom that they talk to if they are having a bad day at school. Orange shapes show students who only speak English, yellow show 'redesignated' students, meaning students who were English learners but now their English language skills have advanced, light blue show English learners, and green show students that were fluent in English upon entry to the school. By looking at both networks, we notice that there are some students (C1: 1, 4, 19; C2: 1, 7, 16, 30) that may be described as isolates, meaning that nobody goes to them nor they talk to anybody if they are having a bad day at school. Visually, we can also see that these networks have the fewest connections in comparison with the previous three networks. Overall, it seems that students in C1 have relatively more sources of emotional support than in C2, as nodes size overall appears to be larger. It also seems that orange nodes (English only students) are a bit more prominent and central, especially in C1. Again here educators may use the toolkit to identify whether students whose English is not their first language struggle with receiving emotional support from peers and accordingly implement

interventions to promote emotional support.

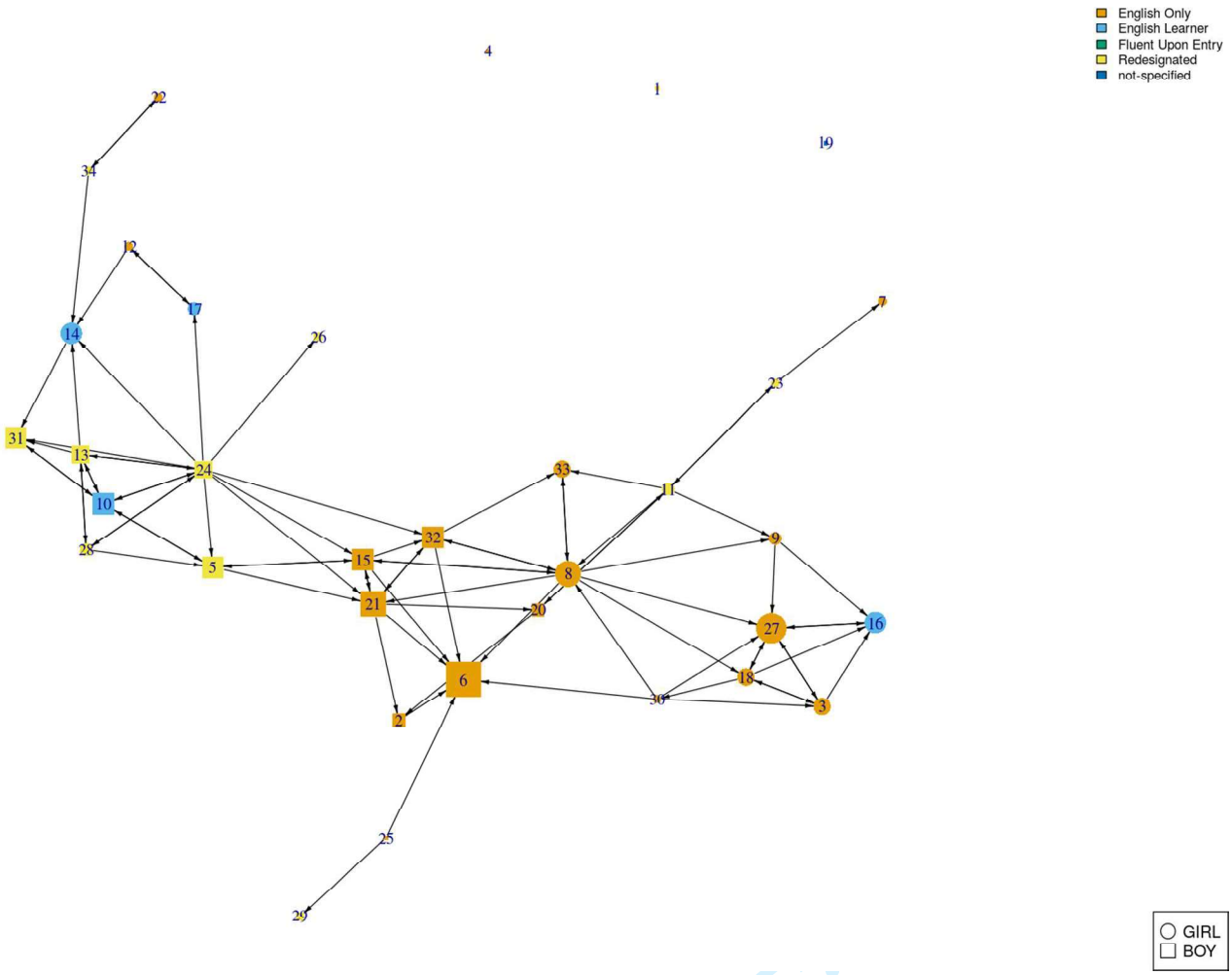


***Figure 7.*** **C1 talk network by gender and English Language Fluency**

In C2, we see gender division as more prominent, with boys not having as many sources of emotional support as girls. Girls in this classroom seem to be much closer and support each other emotionally. Their two main components in the network are much more tightly knit than of those of the boys.

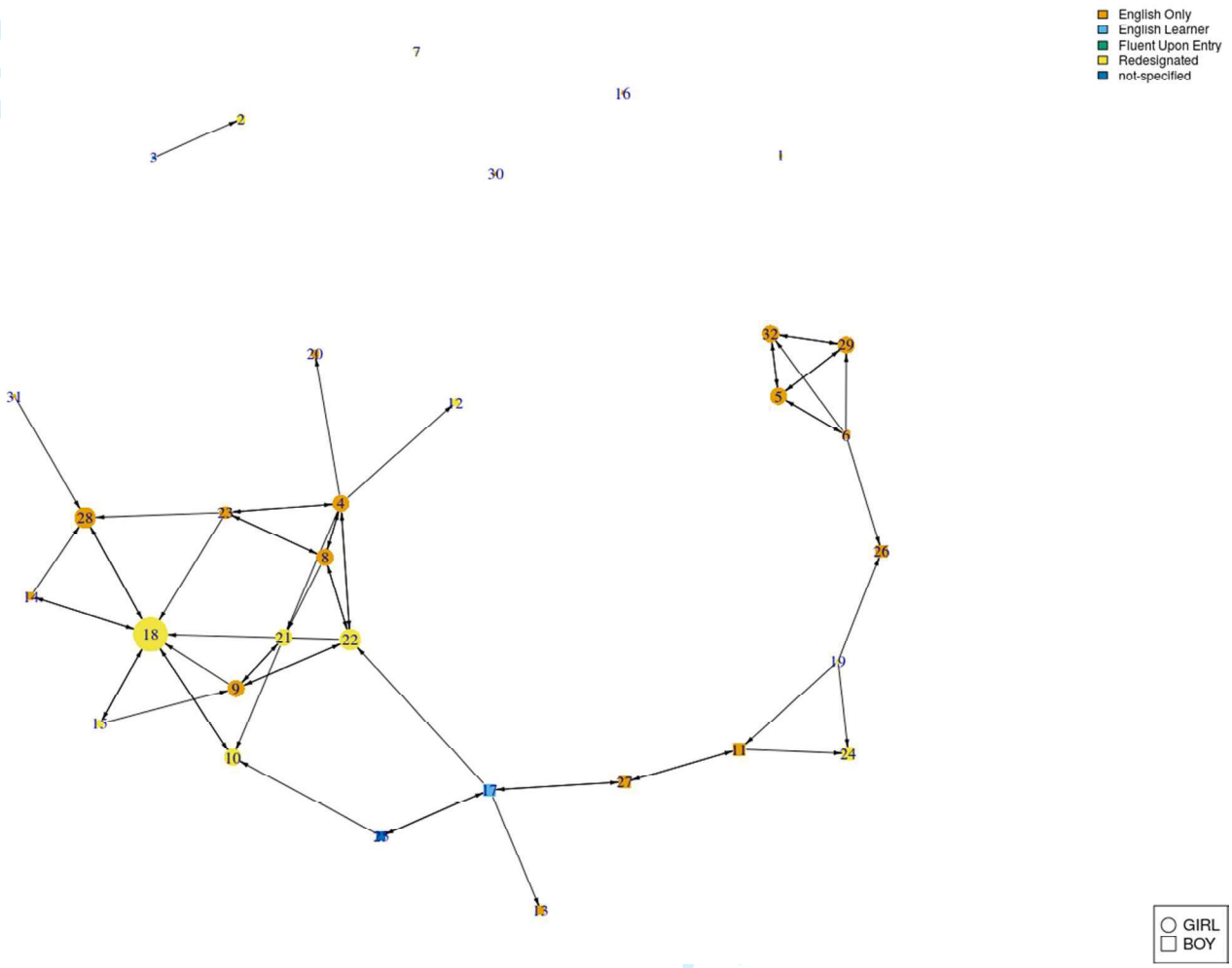


***Figure 8.*** **C2 talk network by gender and English Language Fluency**

Overall, visual network maps produced through the toolkit may provide an immediate 'bird's eye view' of the social dynamics in a classroom. It should be noted that this is only a snapshot of the social relationships in that particular point in time, and more than one snapshots should be taken in order to gain more in-depth insight, particularly into the evolution of network structure and change in relationships. Additionally, depending on what educators and researchers are interested in, a variety of relationships may be examined, in our case friendship, out-of-class interactions, help and emotional support. It is up to educators and researchers to define their relational questions and collect data accordingly.

*SNA measures*

Network maps provided an insightful 'snapshot' of relational data within the two classrooms but they are perhaps not sufficient to tell the whole story. Therefore, when conducting SNA, it is essential to get a closer look at the networks through calculating SNA measures. For example, we can calculate the networks' density or students' in-degree centrality which shows the number of incoming ties to a student. In this section, we focus on five measures, including density, reciprocity (arc and dyad), homophily, and in-degree centrality. We have selected these measures as they provide an indicator of how socially responsive and inclusive a classroom may be. The toolkit provides the possibility to educators and researchers to choose any SNA measure they prefer that best addresses their specific needs or research questions.

In SNA, when we study whole networks, it is useful to distinguish between three levels of analysis: the whole network, the dyad and the node (Borgatti et al., 2013). At the network level of analysis, we have selected density and arc reciprocity as they are often reported in the literature and may assist us in better understanding the relational structure of the classroom. At this level, we may ask questions like 'Do well-connected classrooms tend to be more socially responsive and inclusive?'. At the dyad level, we may study pairwise relations between students and ask questions like 'do pairs of children with friendship ties tend to develop academic or emotional ties and vice versa?'. At this level, we have calculated dyad reciprocity and homophily. At the node level of analysis, we examine the position of individual students within the classroom network. We may ask questions like 'are students with more friends more likely to have more sources of emotional support?'. We have selected in-degree centrality, which refers to the number of incoming ties.

First, measuring *density* of a classroom network is usually defined as the sum of all present ties divided by the number of possible ties (Hanneman & Riddle, 2005). Therefore, density shows how

well connected or not a classroom is, which could be an indicator of how socially responsive this classroom is. Table 3 shows the density of all four networks across the two classrooms.

Table 3. *Density*

| **Network** | **C1** | **C2** |
|---|---|---|
| Friendship | 0.32 | 0.23 |
| Hang out | 0.16 | 0.16 |
| Help | 0.13 | 0.10 |
| Talk | 0.08 | 0.06 |

As shown in table 3, C1 has higher density in three of the four networks, except the hang out network where both classrooms have the same score (16%). This may suggest that resources, knowledge, support and overall social capital can 'flow' easier within a denser network structure, as in C1, whereas sparser network structure may be more conducive towards students' isolation. In both classrooms, we observe that friendship has the highest density scores and then the rate keeps dropping in the subsequent networks, with talk networks having the lowest. This is reflected on all network maps. An advantage of gathering relational data for different types of relationships is that we can obtain a fuller picture of the classroom's social responsiveness and then concentrate our resources and interventions to improve those relationships that seem to be more under strain, such as the talk network. It appears that only 8% (C1) and 6% (C2) of students have a source of emotional support when they are having a bad day at school.

*Reciprocity* is useful with directed relational data, such as friendship nominations within a classroom. At the whole network level, arc reciprocity has been calculated whereas dyad reciprocity has been calculated at the dyad level (see table 4). First, an arc is an ordered pair (x,y) where x sends a tie to y. An arc (x,y) is said to be reciprocated if the arc (y,x) is also present (Borgatti et al., 2002). Therefore, arc reciprocity is the proportion of all outgoing arcs that are reciprocated. Second, dyad reciprocity is the proportion of all dyads that are symmetric (Borgatti et al., *ibid*). In classroom friendship networks, a classroom that has many reciprocated friendships between students may be a more

inclusive and socially responsive where perhaps students enjoy learning as they feel socially valued and integrated. Hanneman and Riddle (2005) note that a network that has a predominance of reciprocated ties may be a more 'equal' or 'stable' network. Table 4 provides arc reciprocity scores for all networks across both classrooms.

Table 4. *Reciprocity*

| Network | C1: Arc | C1: Dyad | C2: Arc | C2: Dyad |
|---|---|---|---|---|
| Friendship | 0.63 | 0.46 | 0.55 | 0.38 |
| Hang out | 0.39 | 0.24 | 0.52 | 0.35 |
| Help | 0.49 | 0.32 | 0.54 | 0.37 |
| Talk | 0.49 | 0.32 | 0.61 | 0.44 |

C1 has higher reciprocity rates in terms of friendship but lower in terms of the remaining three networks. Qualitative work is needed to provide insights into why this may be happening. Additionally, classroom teachers may be in the best position to explain these scores as they spend a lot of time with their students. This is another reason as to why the toolkit may be extremely useful at the hands of educators.

*Homophily* is one more popular measure and is defined as the tendency of students to associate and bond with similar others, such as students of the same gender, race and ethnicity, or disability. McPherson, Smith-Lovin and Cook (2001) famously coined the phrases 'birds of a feather' flock together and 'similarity breeds connection' and defined homophily as the 'principle that a contact between similar people occurs at a higher rate than among dissimilar people' (p.416). It is argued that homophily facilitates individuals' social interactions, such as helping people accessing information and diffusion of behaviors (Christakis & Fowler, 2007). It is particularly a useful concept in the pedagogical practice as it may enable educators and researchers to unpack the social dynamics of similar groups of students and promote inter-group interactions. We have calculated homophily in terms of race/ethnicity and gender, as shown in table 5.

Table 5. *Homophily*

| Network | Gender: C1 | C2 | Race/Ethnicity: C1 | C2 |
|---|---|---|---|---|
| Friendship | -0.19 | -0.59 | -0.06 | 0.19 |
| Hang out | -0.26 | -0.56 | -0.24 | 0.16 |
| Help | -0.32 | -0.77 | -0.15 | 0.01 |
| Talk | -0.56 | -0.80 | -0.09 | -0.05 |

As reflected on the network maps (Fig. 1-4), we can observe significant homophily in terms of gender, particularly in C2 and higher race/ethnicity homophily in C1, especially in the hang out network. Homophily scores range from -1 to +1, the closer to -1 the stronger the homophily is.

At a node level of analysis, in-degree centrality is perhaps the simplest and most useful measure of centrality, which is the number of incoming ties for each student (Borgatti et al., 2013). To put it simply, in a classroom friendship network, the in-degree of a student is 5 if five classmates selected this student as their friend. In a friendship network, students who have high in-degree centrality are usually popular within the classroom. Table 6 provides the in-degree for all students and by SEND status across the classrooms.

Table 6. *Average in-degree centrality*

| | C1 | | | C2 | | |
|---|---|---|---|---|---|---|
| | Total | Non-SEND | SEND | Total | Non-SEND | SEND |
| N | 34 | 27 | 7 | 32 | 24 | 8 |
| Friendship | 10.47 | 11.41 | **6.86** | 7.22 | 7.37 | **6.75** |
| Hang out | 5.32 | 5.59 | **4.29** | 4.94 | 5.00 | **4.75** |
| Help | 4.35 | 4.89 | **2.29** | 3.22 | 3.33 | **2.87** |
| Talk | 2.53 | 2.81 | **1.43** | 1.84 | 1.67 | **2.37** |

Overall, students in C1 have higher in-degree centrality scores, especially in the friendship network (10.47) whereas in C2 the respective score is 7.22. However, the discrepancy between SEND and non-SEND students in C1 is much bigger than in C2. In C2 students with SEND have been reported as receiving nearly as many relational ties as their non-SEND counterparts. In the talk network, they have a higher in-degree score (2.37) than their peers without SEND (1.67), meaning

that more classmates go to them to talk to if they are having a bad day rather than to typically developing peers. In C1, in-degree for SEND students is lower than their peers, especially in the friendship, help and talk networks. In-degree scores may show how popular or isolated some students are. C2 appears to be more socially responsive and perhaps more inclusive to students with SEND as their in-degree scores are relatively comparable to non-SEND students.

*Conclusions*

The use of an SNA toolkit can be valuable in understanding and creating more socially responsive classrooms. The toolkit can act as a 'bridge' between social network researchers (research) and educators (practice). We view this as a new approach to conducting research but also as a powerful tool for personalized professional teacher development and training. First, combining rigorous social network research with educators' insights in the form of participant observation, and informal conversations with their students can be pedagogically transformative. Educators are ideally placed to think and act as ethnographers and use the toolkit as a complementary set of tools to understand and transform the social dynamics within their classrooms. Second, educators can then receive personalized professional development and training based on the findings from their classrooms, as shown in the results section above. In general, this could be a useful pedagogical tool to be used in teaching and learning.

Across the globe, there is an increasing awareness of the importance of social interactions between students as crucial for their learning, well-being, and sense of belonging. What is often less explored or taken into account, and what we think is crucial, is the nested structure of social interactions among students. Many studies focus on relationships among students without paying attention to how these relationships all together form a web of interactions, for example within the classroom, and how students' position within this larger network reflects the opportunities they have for

accessing particular resources (attitudes, knowledge, friendship, support, etc.) or social capital. In this article, we took the view that social network analysis, which allows us to take into account the larger social infrastructure in which students reside, is a pivotal tool for educators and researchers to deepen their understanding of classroom social interactions and peer relationships in order to understand and support students' learning. In addition, by introducing a social network analysis toolkit in this study, we believe a bridge is provided between research and practice in the quest for high quality education.

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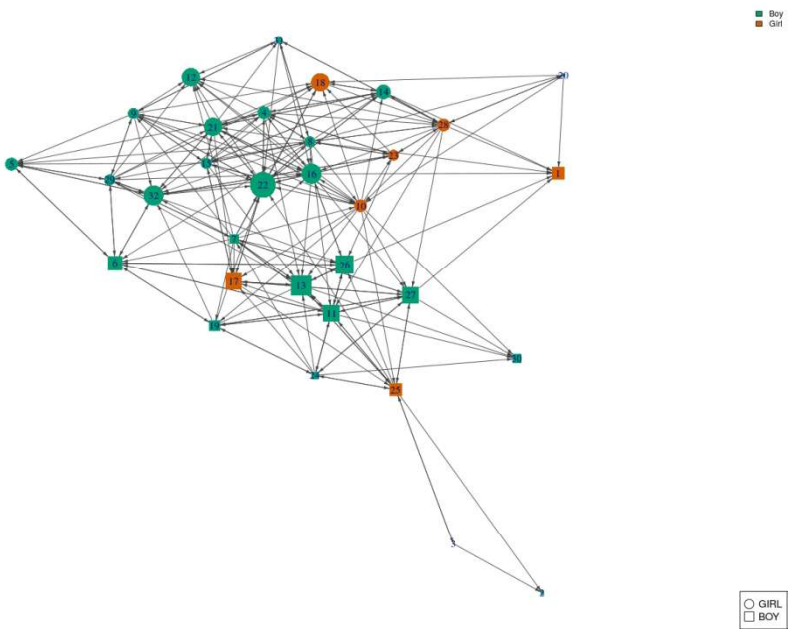


Figure 2. C2 friendship network by gender and SEND